April 18, 2000 F/AKC2:RRL

CRUISE RESULTS
NOAA Ship *Miller Freeman*, Cruise 99-13
1999 West Coast Upper Continental Slope Groundfish
Bottom Trawl Survey
October 14-November 19, 1999

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) completed a five-week bottom trawl survey of the upper continental slope groundfish resources off Washington, Oregon, and California on November 19, 1999. The survey covered the upper continental slope habitat 183-1, 280 m deep in the International North Pacific Fisheries Commission (INPFC) U.S. Vancouver, Columbia, Eureka, Monterey, and northern Conception statistical areas (U.S./Canada border-lat. 34°30 N). Sampling for the survey began near Point Arguello and progressed northward to the U.S./Canada border (Fig. 1). This report summarizes the preliminary results of the survey.

ITINERARY

The 1999 slope survey was conducted during two legs aboard the NOAA Ship *Miller Freeman* between October 14 and November 19. Scientific personnel were exchanged during a mid-cruise break in Astoria, Oregon, on November 8-9.

OBJECTIVES

Results from annual groundfish slope surveys are used by fishery managers to assess stock conditions and establish annual harvest guidelines for sablefish (*Anoplopoma fimbria*), Dover sole (*Microstomus pacificus*), and two species of thornyhead rockfish (*Sebastolobus alascanus* and *S. altivelis*). West Coast upper

continental slope (WCUCS) surveys were conducted in 1984, from 1988 to 1993, and from 1995 to 1997. This was the eleventh survey in an ongoing series to monitor long-term trends in the distribution and abundance of WCUCS groundfish populations.

The specific objectives for this cruise were:

1. to describe and monitor the abundance, biological characteristics, and the geographic and bathymetric distribution of major groundfish resources inhabiting the upper continental slope of the INPFC U.S. Vancouver, Columbia, Eureka, Monterey, and northern Conception statistical areas;

2. to obtain age samples and biological data including sex, length-weight relationships, and maturity for shortspine and longspine thornyhead, sablefish, Dover sole, Pacific grenadier (*Coryphaenoides acrolepis*), and arrowtooth flounder (*Atheresthes stomias*) for stock assessment purposes; and

3. to describe the slope fish community and how it varies with bathymetry.

VESSEL AND GEAR

The NOAA Ship *Miller Freeman* is a 65.5 m stern trawler equipped with a modern trawl sampling system and navigation and fishing electronics. A polyethylene high-opening Nor'eastern bottom trawl, built to RACE Division standards and equipped with mud-sweep roller gear, was used to collect all samples. Dimensions of this net are: 27.2 m headrope and 37.4 m footrope including the "flying wings." The body is constructed of 127-mm stretched-mesh polyethylene netting, 89-mm stretched-mesh web in the codend, and a 32-mm stretched-mesh codend liner. The roller gear is constructed of 203-mm solid rubber disks strung on 16-mm high tensile chain. Connecting the footrope and roller gear at each attachment point is a toggle, two shackles, and a single link of 10-mm alloy chain. Three 55-m dandylines made of 16-mm galvanized steel cable lead from each wing to a 1.8 x 2.7 m steel V-door weighing 1,000 kg. Each door has a 4-point bridle on its backside made with 13-mm long link chain having 33 links forward, top and bottom, and 22 links aft, top and bottom. Instruments attached to the trawl gear to monitor gear performance included

the SCANMAR[1] equipment for measuring net dimensions, a Furuno[1] wireless netsonde for real-time monitoring of the headrope height, and a bottom contact sensor on the footrope. A Wesmar[1] sonar was used to verify good trawl performance during the initial part of the cruise and for proper net configuration during wire marking. A Richard Brancker[1] XL-200 submersible data logger was attached to the trawl and used in conjunction with a Trimble[1] Global Positioning System (GPS) unit to record data on the time, depth, water temperature and geodetic position during each trawl. These data were integrated with fishing dimensions of the net, producing a comprehensive set of data describing gear performance in space and time.

SURVEY DESIGN AND METHODS

The original sampling design used for this survey was a cross between a systematic and random design. Sampling was conducted between 183 and 1,280 m in six strata of 183 m depth intervals (183-366, 367-549, 550-732, 733-914, 915-1,097, 1,098-1,280 m). The design included 208 stations along 32 east-west tracklines spaced 50 km apart between lat. 48^{0}05'N near Nitinat Canyon and lat. 34°30 N near Point Arguello. Most stations were the same as those trawled during 1997 WCUCS survey. Sampling at each station consisted of a controlled bottom trawl haul with net metering instrumentation attached to the trawl to monitor gear performance. After the trawl settled to the bottom, it was towed for 30 minutes using scope ratios ranging from 1.5 to 2.5. Towing speed was approximately 3.7 km/hour (2.3 knots) at all stations and trawling operations continued around the clock (24 hours per day). The trawl s fishing dimensions were monitored with the Furuno netsonde at all depths, and with SCANMAR at stations shallower than 1000 m. Station data, including time, geodetic position, trawl dimensions, distance fished, temperature profile, and catch and length information, were stored for later analysis using shipboard computer systems.

All catches were sorted to the lowest possible taxon, weighed, counted, and processed according to standard RACE protocols. Samples of most fish species caught in every haul were measured for length composition. Stratified otolith (age) samples were collected from the primary target groundfish species by sex-

[1]Reference to trade names or commercial firms does not constitute U.S. government endorsement.

centimeter intervals in three depth strata (183-548 m, 549-913 m, and 914-1,279 m). Other biological data were collected from the major fish species encountered. Special study collections were stored in appropriate fixatives or frozen.

RESULTS

Two-hundred-and-seven (207) tows were attempted during the survey. Out of 208 possible stations, 199 stations were sampled successfully (Fig. 1). Nine stations were abandoned because they were too rough or steep to tow. The remainder of the attempted tows were unsuccessful due to hang-ups, rips, bad bottom, excessive mud in tows, crossing into the wrong stratum, or gear problems. SCANMAR net mensuration data were obtained from 178 tows, submersible bathythermograph data from 201 tows, bottom contact sensor data from 201 tows, and GPS course and position data from 207 tows.

A total of 142 fish species were identified in catches throughout the survey. Samples also contained representatives from numerous orders of invertebrates. Table 1 summarizes the biological data collected from fish species. Specimen ages will be determined by the NMFS Alaska Fisheries Science Center, NMFS Northwest Fisheries Science Center, and the Oregon Department of Fish and Wildlife using the collected otoliths.

Table 2 lists the dominant groundfish species and selected crab species caught during the survey. Catch rates are expressed in kg/ha and ranked in order of catch per unit of effort (CPUE) by depth stratum. Spiny dogfish had the highest mean catch rate in Stratum 1 and Dover sole in Stratum 2. Pacific hake had the second highest catch rate in both strata. Either longspine thornyhead or Dover sole had the highest mean catch rate in Stratum 3 to Stratum 5 and Pacific grenadier had the highest in Stratum 6. Plots of unweighted size frequency of primary groundfish species are provided in Figures 2 through 7, showing their frequency by depth stratum and by sex for the entire survey area. The lengths reported in these figures are all fork lengths except for Pacific grenadier (Fig. 5) which were measured from the snout to the insertion of the anal fin. Further analyses will be completed to describe distribution and to estimate biomass, population size, and age composition of these groundfish resources. Length-weight and length-maturity relationships will be derived to assist managers in assessing the status of important upper slope groundfish species.

SCIENTIFIC PERSONNEL

Leg I (Oct. 14 - Nov. 8):

Day Watch (noon to midnight)

Robert Lauth (Chief Scientist), AFSC	Fishery Biologist
Dan Kamikawa (Deck Boss), NWFSC/N	Fishery Biologist
Jerry Hoff, AFSC	Fishery Biologist
Katherine Pearson, AFSC	Fishery Biologist
Mike Macewan, AFSC	Gear Specialist
Troy Buckley, AFSC	Fishery Biologist

Night Watch (midnight to noon)

Bill Flerx (Watch Leader), AFSC	Fishery Biologist
Robin Harrison (Deck Boss), AFSC	Fishery Biologist
Roger Clark, AFSC	Fishery Biologist
Jim Smart, AFSC	Gear Specialist
Paul Von Szalay, AFSC	Fishery Biologist
Janelle Zimmerman, NWFSC/S	Fishery Biologist

Leg II (Nov. 9 - Nov. 19):

Day Watch (noon to midnight)

Robert Lauth (Chief Scientist), AFSC	Fishery Biologist
Dan Kamikawa (Deck Boss), NWFSC/N	Fishery Biologist
Mark Wilkins, AFSC	Fishery Biologist
Allen Harvison, AFSC	Gear Specialist
Lisa Appesland, AFSC	Fishery Biologist
Bob Mikus, ODFW	Fishery Biologist

Night Watch (midnight to noon)

Bill Flerx (Watch Leader), AFSC	Fishery Biologist
Jay Orr (Deck Boss), AFSC	Fishery Biologist
Russ Nelson, AFSC	Gear Specialist
Frank Morado, AFSC	Fishery Biologist
Scott McKillip, AFSC	Gear Specialist
Debbie Nebenzahl, AFSC	Fishery Biologist

AFSC = Alaska Fisheries Science Center, Seattle, WA
NWFSC/S = Northwest Fisheries Science Center, Newport, OR
NWFSC/N = Northwest Fisheries Science Center, Newport, OR
ODFW = Oregon Department of Fish and Wildlife, Newport, OR

For further information, contact Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE., BIN C15700, Building 4, Seattle, WA 98115-0070. Telephone (206) 526-4170.

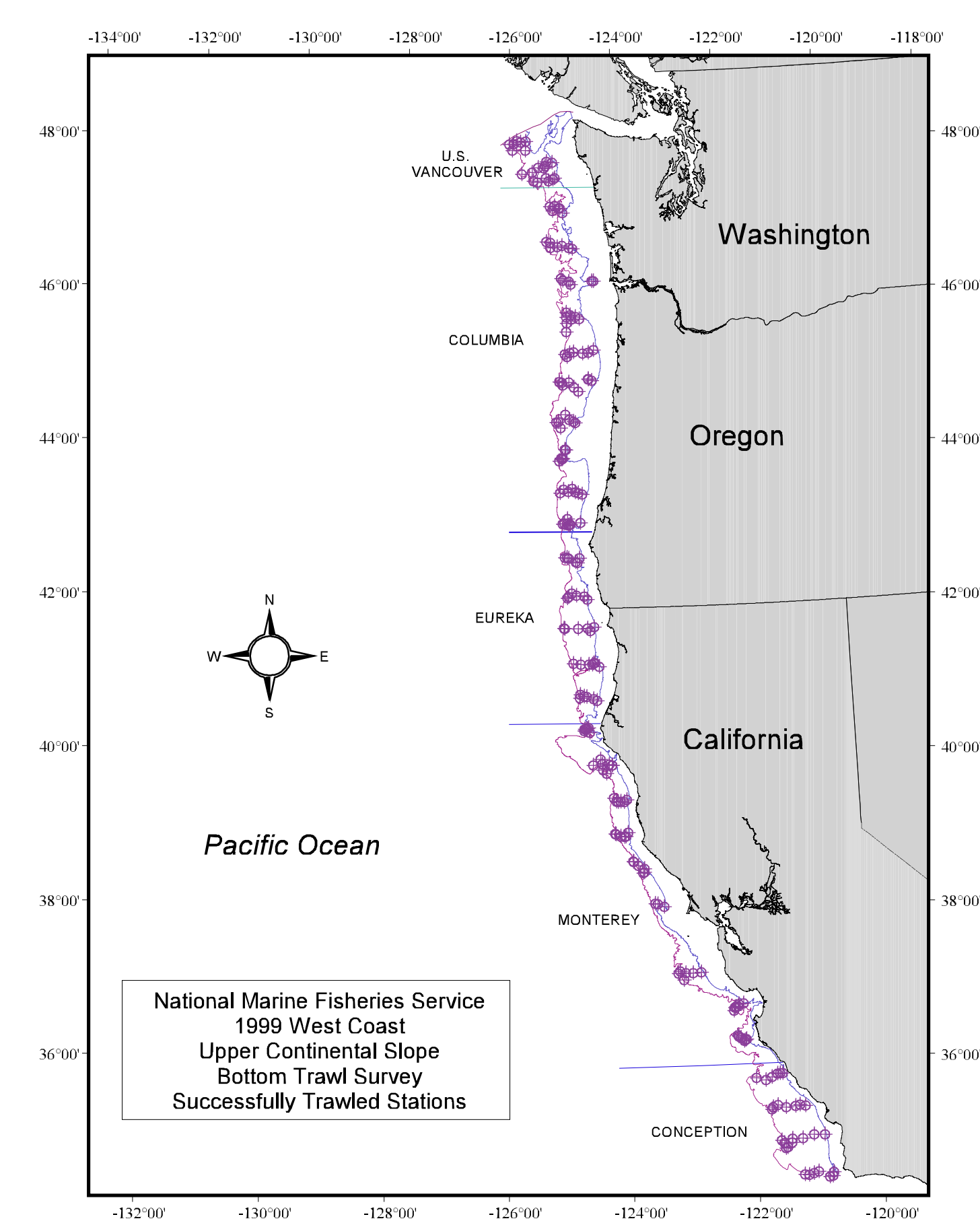

Figure 1.--Map showing the location of 199 successful bottom trawl tows sampled during the 1999 West Coast upper continental slope groundfish trawl survey.

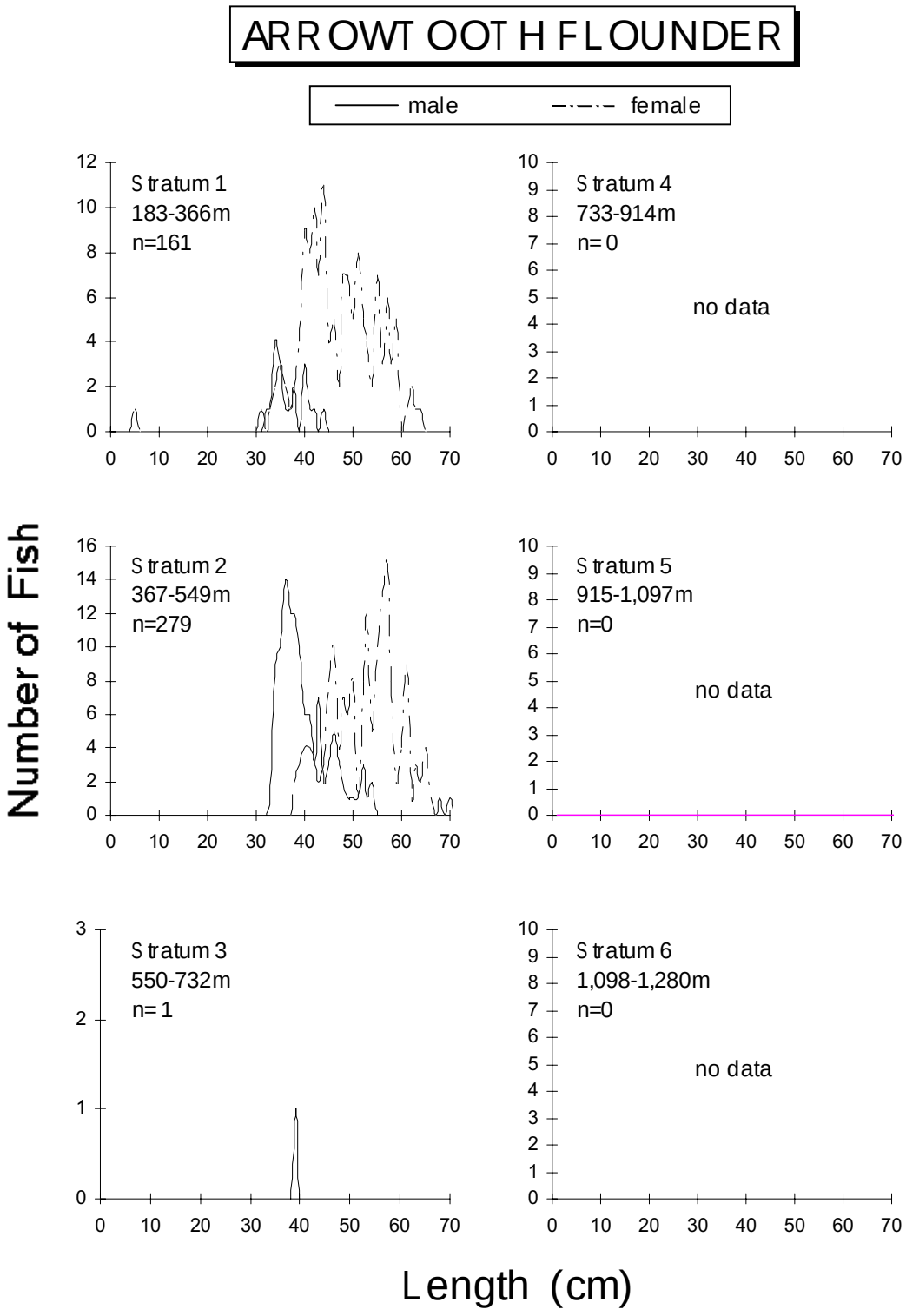

Figure 2.--Unweighted length frequency of arrowtooth flounder by sex and by stratum for the 1999 West Coast upper continental slope bottom trawl survey.

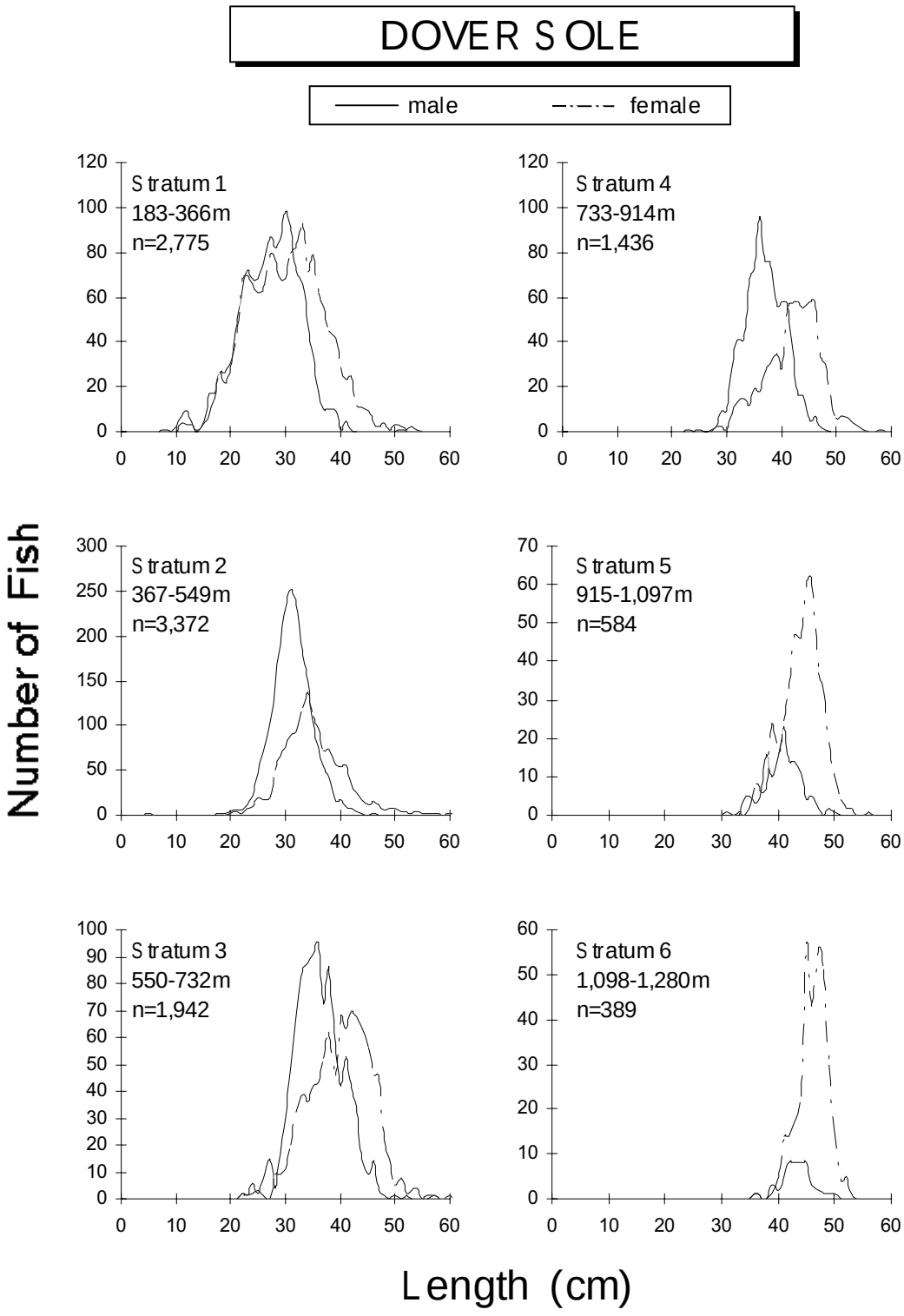

Figure 3.--Unweighted length frequency of Dover sole by sex and by stratum for the 1999 West Coast upper continental slope bottom trawl survey.

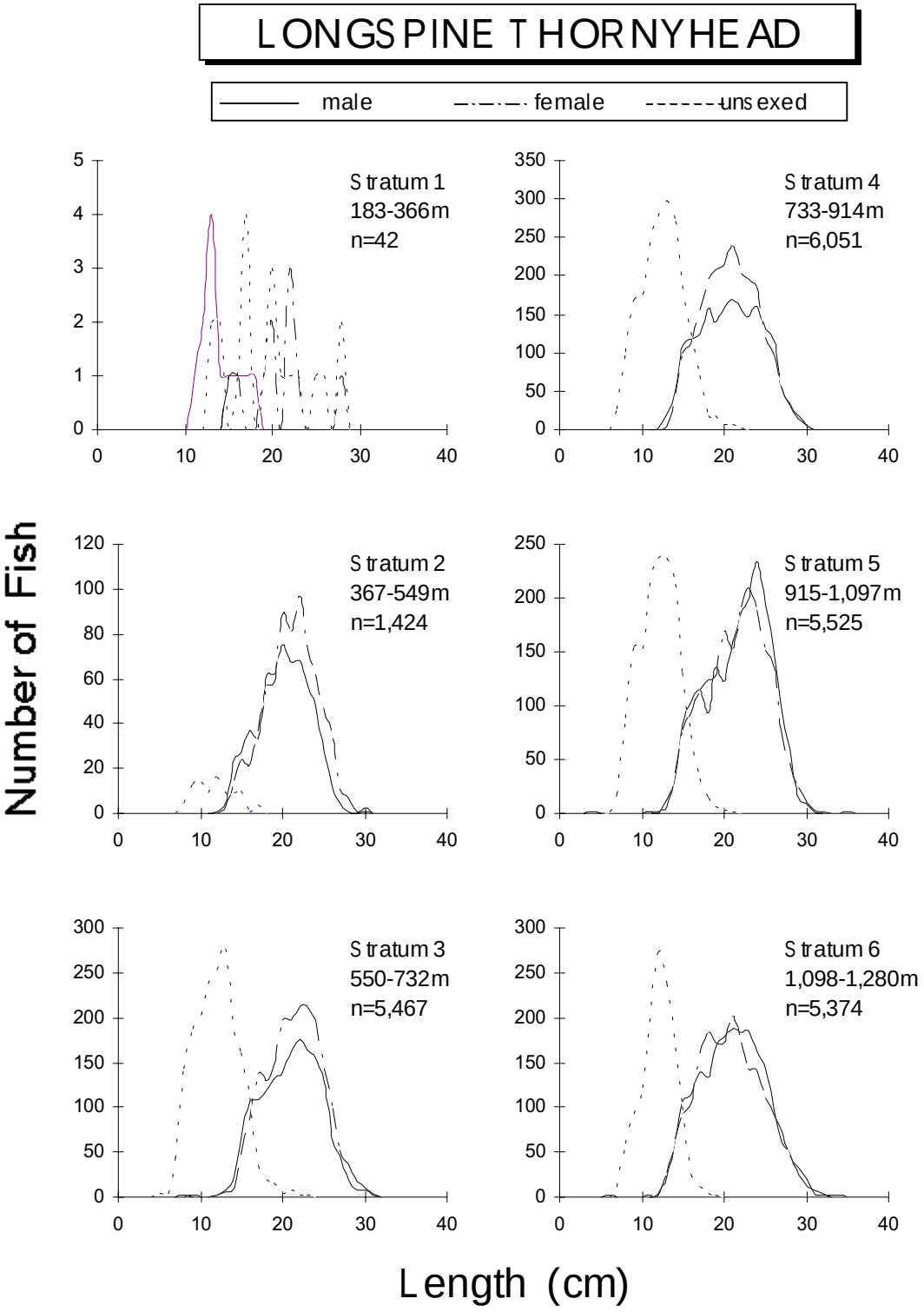

Figure 4.--Unweighted length frequency of longspine thornyhead by sex and by stratum for the 1999 West Coast upper continental slope bottom trawl survey.

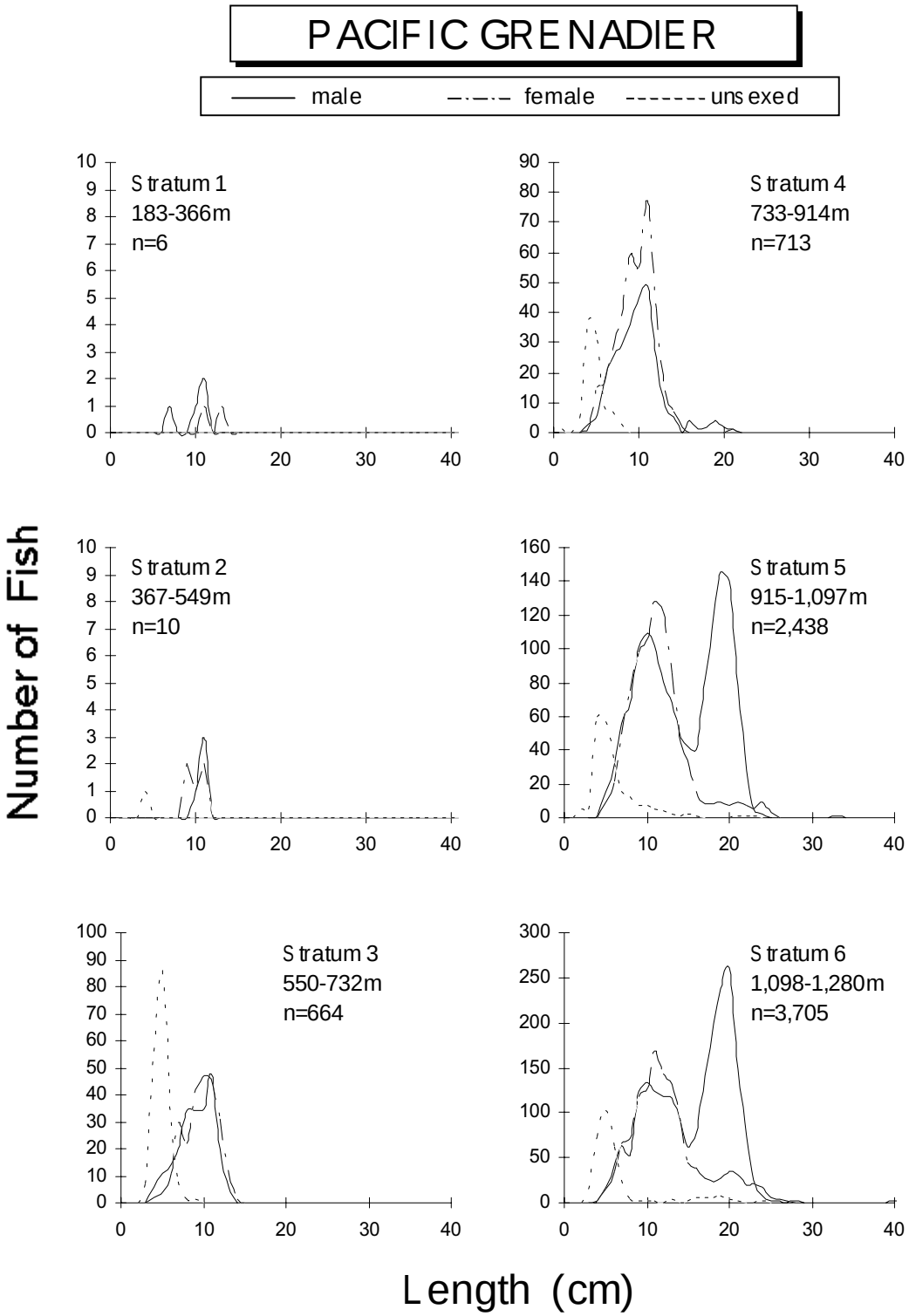

Figure 5.--Unweighted length frequency of Pacific grenadier by sex and by stratum for the 1999 West Coast upper continental slope bottom trawl survey.

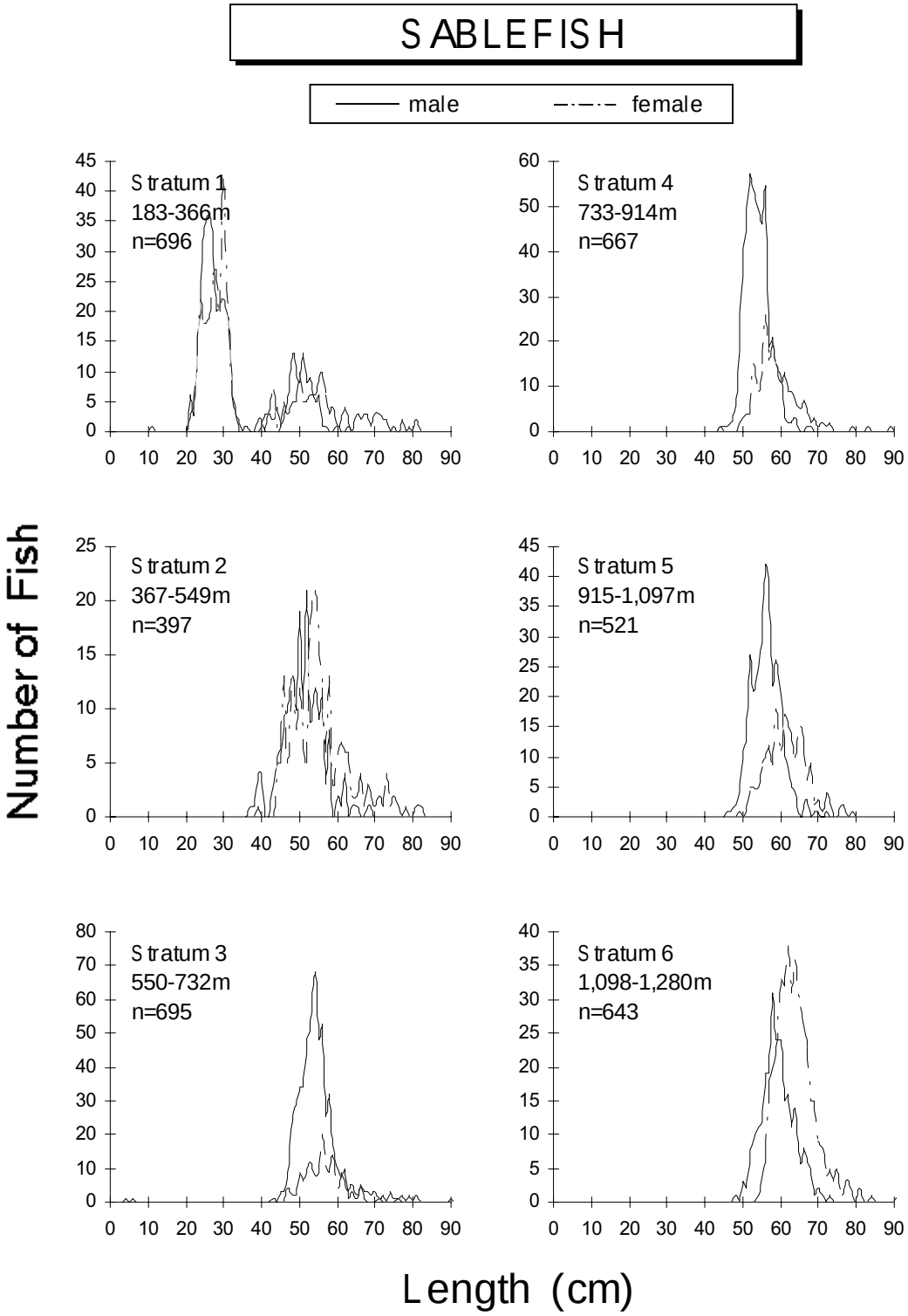

Figure 6.--Unweighted length frequency of sablefish by sex and by stratum for the 1999 West Coast upper continental slope bottom trawl survey.

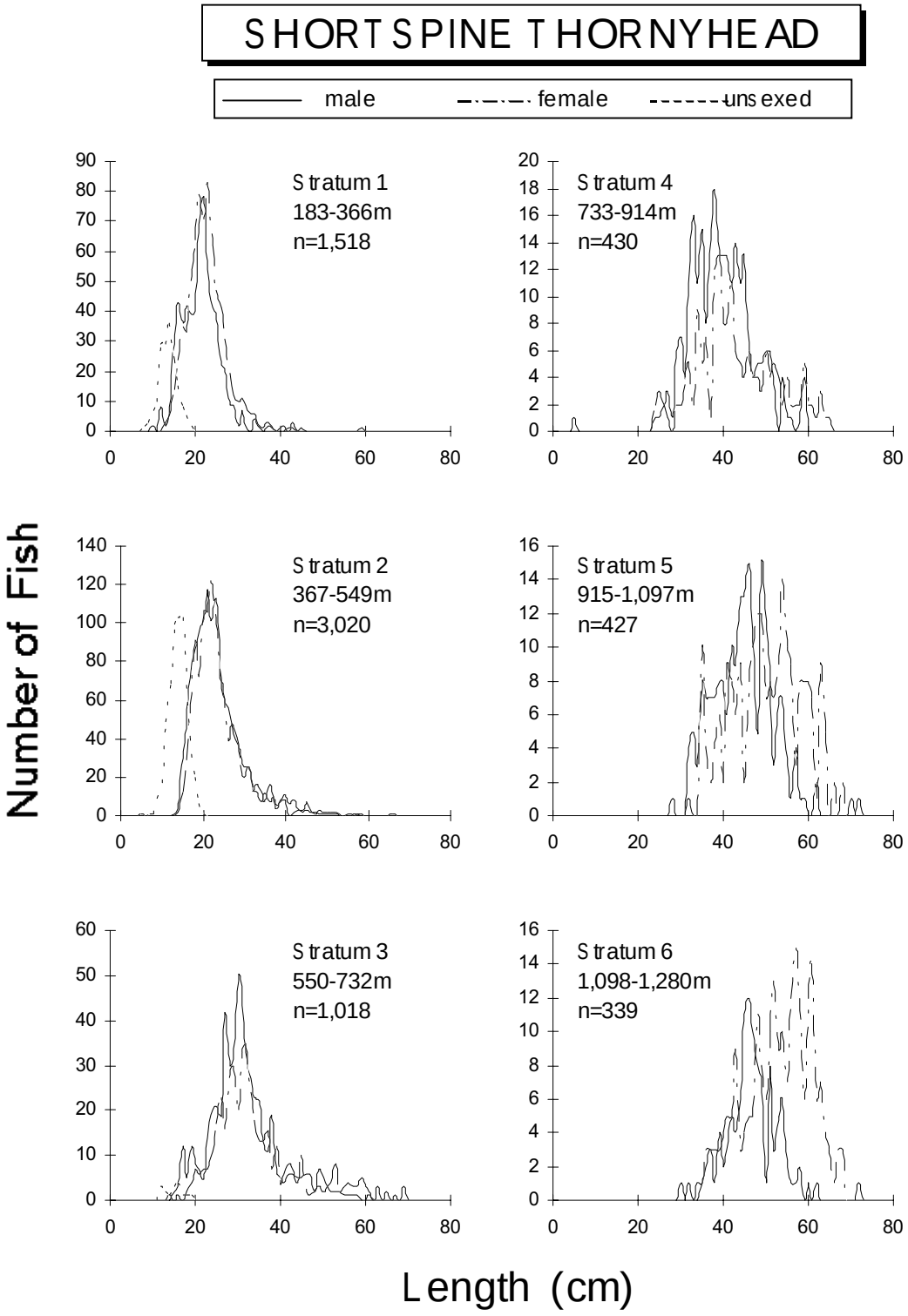

Figure 7.--Unweighted length frequency of shortspine thornyhead by sex and by stratum for the 1999 West Coast upper continental slope bottom trawl survey.

Table 1.--Biological data collected during the 1999 West Coast upper continental slope groundfish trawl survey.

Common Name of Fish Species	Length Measurements	Age Structures	Fish Weights	Maturities	Ovary Samples	DNA Tissue Samples	Stomach Samples
Brown cat shark	3,038	-	81	-	-	-	-
Filetail cat shark	501	-	5	-	-	-	-
Longnose cat shark	91	-	-	-	-	-	-
Spiny dogfish	1,984	-	-	-	-	-	-
Deepsea skate	25	-	16	-	-	-	-
Big skate	3	-	3	-	-	-	-
Bering skate	877	-	314	-	-	-	-
Longnose skate	1,026	-	461	-	-	-	-
Black skate	303	-	141	-	-	-	-
Spotted ratfish	77	-	-	-	-	-	-
Pacific sanddab	145	-	-	-	-	-	-
Arrowtooth flounder	441	247	247	-	23	-	-
Pacific halibut	15	-	-	-	-	-	-
Flathead sole	1	-	-	-	-	-	-
Slender sole	3,870	-	35	-	-	-	-
Petrale sole	424	-	-	-	-	-	-
English sole	781	-	-	-	-	-	-
Dover sole	10,498	1,628	1,628	-	-	-	-
Deepsea sole	1,560	-	-	-	-	-	-
Rex sole	5,505	-	-	-	-	-	-
Bigeye poacher	21	-	-	-	-	-	-
California slickhead	3,939	-	-	-	-	-	-
Threadfin slickhead	650	-	46	-	-	-	-
Sablefish	3,634	1,395	1,395	1,176	-	-	-

Table 1.--Continued.

Common Name of Fish Species	Length Measurements	Age Structures	Fish Weights	Maturities	Ovary Samples	DNA Tissue Samples	Stomach Samples
Jack mackerel	52	-	-	-	-	-	-
California grenadier	29	-	-	-	-	-	-
Smooth grenadier	61	-	-	-	-	-	-
Pacific grenadier	8,260	861	861	-	-	-	-
Giant grenadier	3,510	-	287	-	-	-	-
Popeye grenadier	82	-	-	-	-	-	-
Threadfin sculpin	14	-	-	-	-	-	-
Pacific cod	7	-	-	-	-	-	-
Pacific flatnose	5,177	-	186	-	-	-	-
Lingcod	31	-	-	-	-	25	-
Blacktail snailfish	215	-	-	-	-	-	-
Pacific hake	8,086	-	-	-	-	-	1,119
Chinook salmon	109	-	-	-	-	-	-
Twoline eelpout	1,374	-	-	-	-	-	-
Snakehead eelpout	666	-	-	-	-	-	-
Bigfin eelpout	2,605	-	-	-	-	-	-
Black eelpout	1,660	-	-	-	-	-	-
Blackbelly eelpout	165	-	-	-	-	-	-
Shortspine thornyhead	-	6,754	1,938	1,938	-	234	-
Longspine thornyhead	24,018	1,513	1,513	-	79	-	-
Rougheye rockfish	25	1	1	-	-	-	-
Pacific ocean perch	562	-	-	-	-	-	-
Aurora rockfish	1,131	-	-	-	-	-	-
Silvergray rockfish	5	-	-	-	-	1	-

Table 1.--Continued.

Common Name of Fish Species	Length Measurements	Age Structures	Fish Weights	Maturities	Ovary Samples	DNA Tissue Samples	Stomach Samples
Greenspotted rockfish	9	-	-	-	-	-	-
Darkblotched rockfish	259	-	-	-	-	-	-
Splitnose rockfish	2,290	-	-	-	-	-	-
Greenstriped rockfish	412	-	-	-	-	25	-
Widow rockfish	89	-	-	-	-	25	-
Yellowtail rockfish	167	-	-	-	-	-	-
Pygmy rockfish	6	-	-	-	-	-	-
Sharpchin rockfish	581	-	-	-	-	25	-
Bank rockfish	23	-	-	-	-	-	-
Shortraker rockfish	8	-	-	-	-	-	-
Yellowmouth rockfish	34	-	-	-	-	-	-
Chilipepper	176	-	-	-	-	-	-
Rosethorn rockfish	88	-	-	-	-	-	-
Shortbelly rockfish	360	-	-	-	-	4	-
Cowcod	7	-	-	-	-	-	-
Blackgill rockfish	339	128	128	-	-	1	-
Bocaccio	29	9	9	-	-	9	-
Canary rockfish	9	-	-	-	-	1	-
Redstripe rockfish	163	-	-	-	-	25	-
Redbanded rockfish	56	-	-	-	-	1	-
Stripetail rockfish	1,228	-	-	-	-	-	-

Table 2.--Mean CPUE (kg/ha) of the 20 most abundant groundfish and selected crab species caught during the 1999 West Coast upper continental slope groundfish survey.

Species	Stratum 1 183-366 m	Species	Stratum 2 367-549 m	Species	Stratum 3 550-732 m
Spiny dogfish	84.53	Dover sole	40.07	Dover sole	20.12
Pacific hake	39.88	Pacific hake	27.34	Longspine thornyhead	19.22
Shortbelly rockfish	30.34	Rex sole	13.88	Sablefish	11.32
Dover sole	15.07	Spiny dogfish	8.21	True Tanner crab	9.42
Rex sole	13.69	Shortspine thornyhead	6.08	Shortspine thornyhead	5.13
Splitnose rockfish	10.91	Longnose skate	5.88	Giant grenadier	2.75
Stripetail rockfish	9.99	Sablefish	5.49	Pacific hake	1.62
Spotted ratfish	9.17	Bigfin eelpout	3.79	Brown cat shark	1.49
Longnose skate	8.10	Aurora rockfish	3.20	Black eelpout	0.90
Pacific ocean perch	7.04	Arrowtooth flounder	3.00	California slickhead	0.84
Slender sole	5.76	Longspine thornyhead	2.50	Pacific flatnose	0.81
Sablefish	5.40	Splitnose rockfish	2.44	Twoline eelpout	0.55
Pacific sanddab	4.70	Brown cat shark	2.16	Pacific grenadier	0.54
English sole	4.20	Pacific ocean perch	1.98	Rex sole	0.53
Yellowtail rockfish	3.99	Blackgill rockfish	1.96	Longnose skate	0.53
Petrale sole	3.95	Bering skate	1.88	Deepsea sole	0.47
Sharpchin rockfish	2.82	Pacific halibut	0.91	Filetail cat shark	0.41
Shortspine thornyhead	2.80	Slender sole	0.89	Black skate	0.40
Darkblotched rockfish	2.57	Black eelpout	0.76	Bigfin eelpout	0.24
Bering skate	2.18	Spotted ratfish	0.56	Blacktail snailfish	0.22
Number of hauls	34	Number of hauls	35	Number of hauls	33

Species	Stratum 4 733-914 m	Species	Stratum 5 915-1,097 m	Species	Stratum 6 1,098-1,280 m
Longspine thornyhead	39.52	Longspine thornyhead	30.03	Pacific grenadier	21.16
Dover sole	19.73	Dover sole	12.58	Longspine thornyhead	19.94
Sablefish	9.92	Pacific grenadier	9.14	Giant grenadier	17.76
True Tanner crab	9.22	Sablefish	8.71	Sablefish	12.19
Shortspine thornyhead	3.70	Giant grenadier	6.85	Dover sole	10.34
Giant grenadier	3.57	Shortspine thornyhead	5.78	Shortspine thornyhead	5.14
California slickhead	2.77	True Tanner crab	5.62	diomedeae	4.14
Deepsea sole	1.61	California slickhead	5.23	Pacific flatnose	3.83
Twoline eelpout	1.10	Deepsea sole	2.53	California slickhead	3.72
Brown cat shark	1.05	Pacific flatnose	1.26	True Tanner crab	3.40
Pacific grenadier	0.64	Twoline eelpout	0.94	Black skate	1.70
Threadfin slickhead	0.57	Black skate	0.85	Deepsea sole	1.66
Black skate	0.35	Snakehead eelpout	0.40	Twoline eelpout	1.33
Pacific flatnose	0.27	Brown cat shark	0.37	Deepsea skate	0.85
Hagfish unident.	0.24	Hagfish unident.	0.23	Paralomis multispina	0.68
Snakehead eelpout	0.20	Deepsea skate	0.22	Blob sculpin	0.26
Pacific hake	0.18	Spiny dogfish	0.16	Brown cat shark	0.21 #
Black eelpout	0.15	Blob sculpin	0.15	Popeye grenadier	0.13
Triangle Tanner crab	0.10	Threadfin slickhead	0.15	Blacksmelt unident.	0.12
Blacksmelt unident.	0.09	Blacksmelt unident.	0.11	Longnose cat shark	0.09
Number of hauls	31	Number of hauls	32	Number of hauls	34